

University of Wollongong

Research Online

---

Faculty of Engineering and Information  
Sciences - Papers: Part A

Faculty of Engineering and Information  
Sciences

---

1-1-2014

## Low-energy electron scattering from $\alpha$ -tetrahydrofurfuryl alcohol

Luca Chiari

*Flinders University*

Darryl Jones

*Flinders University*

Penny Thoi

*Flinders University*

Michael J. Brungei

*Flinders University, University of Malaya*

Gustavo Garcia

*University of Wollongong*

*See next page for additional authors*

Follow this and additional works at: <https://ro.uow.edu.au/eispapers>



Part of the [Engineering Commons](#), and the [Science and Technology Studies Commons](#)

---

### Recommended Citation

Chiari, Luca; Jones, Darryl; Thoi, Penny; Brungei, Michael J.; Garcia, Gustavo; and Blanco, Francisco, "Low-energy electron scattering from  $\alpha$ -tetrahydrofurfuryl alcohol" (2014). *Faculty of Engineering and Information Sciences - Papers: Part A*. 3228.

<https://ro.uow.edu.au/eispapers/3228>

Research Online is the open access institutional repository for the University of Wollongong. For further information contact the UOW Library: [research-pubs@uow.edu.au](mailto:research-pubs@uow.edu.au)

---

## Low-energy electron scattering from $\alpha$ -tetrahydrofurfuryl alcohol

### Abstract

We report on differential cross section results for low-energy electron collisions with the biologically relevant species  $\alpha$ -tetrahydrofurfuryl alcohol. Electron-impact excitation measurements of the electronic states of  $\alpha$ -tetrahydrofurfuryl alcohol were carried out at incident energies between 15-50 eV and for scattering angles in the range 20-90 degrees. Elastic differential cross section have also been calculated within the Independent Atom Model and using the Screening Corrected Additivity Rule approach at selected energies between 1-1000 eV.

### Keywords

alcohol, tetrahydrofurfuryl, electron, scattering, low, energy

### Disciplines

Engineering | Science and Technology Studies

### Publication Details

Chiari, L., Jones, D., Thorn, P., Brunger, M. J., Garcia Gomez-Tejedor, G. & Blanco, F. (2014). Low-energy electron scattering from  $\alpha$ -tetrahydrofurfuryl alcohol. In XXVIII International Conference on Photonic, Electronic and Atomic Collisions, 24-30 July, Lanzhou, China. Journal of Physics: Conference Series, 488 (5), 1-1.

### Authors

Luca Chiari, Darryl Jones, Penny Thoi, Michael J. Brunger, Gustavo Garcia, and Francisco Blanco

## Low-energy electron scattering from $\alpha$ -tetrahydrofurfuryl alcohol

This content has been downloaded from IOPscience. Please scroll down to see the full text.

2014 J. Phys.: Conf. Ser. 488 052003

(<http://iopscience.iop.org/1742-6596/488/5/052003>)

View [the table of contents for this issue](#), or go to the [journal homepage](#) for more

Download details:

IP Address: 130.130.37.84

This content was downloaded on 15/01/2015 at 23:50

Please note that [terms and conditions apply](#).

## Low-energy electron scattering from $\alpha$ -tetrahydrofurfuryl alcohol

Luca Chiari<sup>†</sup>, Darryl Jones<sup>\* 1</sup>, Penny Thorn<sup>†</sup>, Michael J. Brunger<sup>†,‡</sup>, Gustavo Garcia<sup>+,#</sup> and Francisco Blanco<sup>&</sup>

<sup>†</sup> ARC Centre of Excellence for Antimatter-Matter Studies, School of Chemical and Physical Sciences, Flinders University, Adelaide SA, Australia

<sup>\*</sup> School of Chemical and Physical Sciences, Flinders University, Adelaide SA, Australia

<sup>‡</sup> Institute of Mathematical Sciences, University of Malaya, Kuala Lumpur, Malaysia

<sup>+</sup> Instituto de Física Fundamental, Consejo Superior de Investigaciones Científicas, Madrid, Spain

<sup>#</sup> Centre for Medical Radiation Physics, University of Wollongong, Wollongong NSW, Australia

<sup>&</sup> Departamento de Física Atómica, Molecular y Nuclear, Universidad Complutense de Madrid, Madrid, Spain

**Synopsis** We report on differential cross section results for low-energy electron collisions with the biologically relevant species  $\alpha$ -tetrahydrofurfuryl alcohol. Electron-impact excitation measurements of the electronic states of  $\alpha$ -tetrahydrofurfuryl alcohol were carried out at incident energies between 15-50 eV and for scattering angles in the range 20-90°. Elastic differential cross section have also been calculated within the Independent Atom Model and using the Screening Corrected Additivity Rule approach at selected energies between 1-1000 eV.

Investigations of low-energy electron interactions with the sub-units of the nucleic acids, or their analogues, have in recent years become a topical field of study in atomic and molecular physics in order to understand how charged particles can induce damage in biomolecular systems [1]. The knowledge of the collision cross sections, which define the probability of specific scattering events, is particularly useful in simulating how energy is deposited in the biological medium, and can thus be used to characterise the extent of any radiation-induced damage.

$\alpha$ -tetrahydrofurfuryl alcohol (THFA,  $C_5H_{10}O_2$ ) is a close chemical analog of the sugar rings present in the phosphate-deoxyribose backbone structure of the nucleic acids [2]. As such, THFA can be considered as a suitable analogue for investigating how low-energy electrons interact with the larger macro-molecules found in biological systems.

Here we report on differential cross section (DCS) measurements for the low-energy electron-impact excitation of the electronic states of THFA. For this purpose, electron energy loss spectra (EELS) have been measured at selected incident energies between 15 eV and 50 eV and for scattering angles in the 20-90° range. These experiments were carried out on an electron spectrometer located at Flinders University, with the details of its construction and operation being presented elsewhere [3].

EELSs at each incident electron energy and scattering angle are then converted into DCSs by comparing the relative intensity observed between the inelastic and elastic scattering fea-

tures. Here the absolute scale of the inelastic cross sections is set by the absolute scale of the elastic DCSs. These were obtained from calculations performed within the Independent Atom Model with the Screening Corrected Additivity Rule formalism (see e.g. [4]) at energies spanning 1-1000 eV.

The present low-energy experimental results are compared against the existing intermediate-energy electron-impact excitation results [5]. In order to understand the importance of chemical substitutions in low-energy electron interactions, we also compare the present inelastic DCSs for THFA to our previous low-energy electron-impact excitation results for the structurally related species tetrahydrofuran [6].

The present work significantly contributes to our understanding of low-energy electron interactions with biomolecules. This understanding is essential for developing accurate models and interpreting results of radiation-induced damage in biological systems.

## References

- [1] G García Gómez-Tejedor and M C Fuss 2012 *Radiation Damage in Biomolecular Systems* (Berlin: Springer)
- [2] A R Milosavljević *et al* 2006 *Eur. Phys. J. D* **40** 107
- [3] M J Brunger and P J O Teubner 1990 *Phys. Rev. A* **41** 1413
- [4] F Blanco and G García 2004 *Phys. Lett. A* **330** 230
- [5] A R Milosavljević *et al* 2008 *J. Phys. Conf. Ser.* **101** 012014
- [6] T P T Do *et al* 2011 *J. Chem. Phys.* **134** 144302

<sup>1</sup> E-mail: [darryl.jones@flinders.edu.au](mailto:darryl.jones@flinders.edu.au)

